

# Operating Experience Summary



## Office of Nuclear and Facility Safety

March 28 — April 12, 2000

Summary 2000-07

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# Operating Experience Summary 2000-07

## March 28 through April 12, 2000

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## EVENTS

### 1. SELF-CONTAINED BREATHING APPARATUS CYLINDER DEFECTS

On March 30, 2000, Savannah River Central Services filed a report concerning potential defects in high-pressure aluminum seamless and composite aluminum self-contained breathing apparatus (SCBA). Scott Aviation SBCA cylinders made of aluminum alloy 6351-T6, rated at 2216 psig, and manufactured by *Luxfer Gas Cylinders*, have been found to be susceptible to sustained load cracking. This information is derived from a National Institute for Occupational Safety and Health (NIOSH) Respirator User Notice issued on December 7, 1999. Cylinder rupture could occur, resulting in serious injury, death and/or property damage. (ORPS Report SR--WSRC-CSWE-2000-0007)

The Savannah River lessons learned group issued a notification on February 16, 2000, which summarized the NIOSH notification. The notification informed users of self-contained breathing apparatus that certain high-pressure aluminum seamless and aluminum composite hoop-wrapped cylinders made of aluminum alloy 6351-T6 are susceptible to sustained load cracking in the neck and shoulder area. If such cracks are not detected during visual inspection, defects may still exist and cylinder rupture could still occur, especially during filling. A number of cracked cylinders have been found using a video borescope after the issuance of the lesson learned notice.

The NIOSH Respirator User Notice states in safety precaution number 6, that the *Luxfer*-recommended fill rate for DOT 3AL cylinders made from 6351-T6 alloy should be below 600 psig per minute. Prior to the publication of the NIOSH notice the maximum fill rate for all 21216 psig cylinders was 1500 psig per minute. This new fill rate restriction applies to cylinders marked DOT-3AL 2216, E-6498, E6498 2216 and SP-6498 manufactured by *Luxfer*. These cylinders manufactured prior to 1989 can be identified by looking on the upper cylinder dome area. The serial number, DOT 3A and manufacture date will be stamped into the neck along with the re-test dates. Scott Aviation also issued an Important Safety Notice on February 7, 2000 supplementing their H/S 6177 notice dated November 3, 1999.

The NIOSH notice suggested the following steps be taken to minimize risk to users of SCBA.

- Increase the frequency of internal visual inspection.
- Inspections should be performed by qualified individuals.
- Submit cylinders for non-destructive testing at regular intervals between required requalification testing.
- Do not refill any cylinder that has lost internal pressure for no apparent reason.
- Cylinders should only be refilled in a manner which limits risk to personnel and property.
- Use proper cylinder filling equipment and procedures and refrain from fast-filling.
- Check for valid re-test date before filling.

Further information may be found by contacting Luxfer, NIOSH or The Compressed Gas Association.

LUXFER Gas Cylinders  
909-684-5110  
www.luxfercylinders.com

Compressed Gas Association  
703-412-0900  
www.cganet.com

Scott Aviation  
1-800-633-3915  
www.scottaviation.com

NIOSH Technical Information Hotline 1-800-356-4674, [www.cdc.gov/niosh/homepage.html](http://www.cdc.gov/niosh/homepage.html)

**KEYWORDS:** air bottle, cylinder, SBCA

**FUNCTIONAL AREAS:** industrial safety, respirators

## 2. ROCKY FLATS POTENTIAL PLUTONIUM UPTAKES

On March 10, 2000, at Rocky Flats, a continuous air monitor alarm sounded, indicating a possible plutonium release. Eleven workers were in the alarm's vicinity and could have been exposed. A radiological technician conducted a survey of the area and found no contamination. The workers tested negative for surface contamination; bioassay results are pending. Facility management held a fact-finding meeting to determine the cause of the event and issue corrective actions. (ORPS Report RFO--KHLL-SOLIDWST-2000-0012).

On March 15, 2000, at Rocky Flats, a continuous air monitor alarm sounded while decontamination and decommissioning workers performed waste size reduction. The continuous air monitor readout indicated a plutonium release and a radiological technician evacuated the area to prevent further potential exposure. Potential intake factor calculations for the workers indicated exposure levels below the maximum allowable dosage. Facility management held a fact-finding meeting to determine the cause of the event and issue corrective actions. (ORPS Report RFO--KHLL-SOLIDWST-2000-0015).

On February 28, 2000, at Rocky Flats, a worker received positive results from a routine nasal smear taken in late January after working in supplied air operations. Internal dosimetry notified the radiological operations supervisor that the results of the worker's smears indicated contamination levels that were higher than decision level. Internal dosimetry requested a fecal sample evaluation on February 9, 2000, and on March 9, the results of that evaluation indicated that the worker had an exposure of 110 millirem. Facility management pulled the worker's dosimeter and placed him on further evaluation. There were no other injuries associated with any of these events. Working in radiological control zones can lead to exposure despite the best safety practices. (ORPS Report RFO--KHLL-771OPS-2000-0012).

EH engineers identified the following events involving plutonium exposure.

- Operating Experience Summary 98-47 reported that on September 1, 1998, at the Idaho National Environmental and Engineering Laboratory, the radiation control supervisor at the Idaho Nuclear Technology and Engineering Center (INTEC) received routine annual fecal bioassay results indicating that a laboratory analyst had received an uptake of plutonium-239. The analyst submitted additional fecal samples on September 3, 8, 15, and 22. These follow-up samples showed no radioactivity, indicating that the initial bioassay result had been due to ingestion, not inhalation. The committed effective dose equivalent associated with the ingestion is less than 0.1 mrem. Investigators determined that the analyst worked on samples of plutonium-contaminated graphite molds, and that the requirement to work on the samples inside a glovebox was not adequately communicated to him. (ORPS Report ID--LITC-LANDLORD-1998-0027)
- Operating Experience Summary 95-05 reported that on January 17, 1995, a radiological control inspector (RCI) at the H-Canyon facility at the Savannah River Site tested positive for plutonium-238 on two consecutive bioassay samples. Facility personnel calculated the 50-year Committed Effective Dose Equivalent (CEDE) to be 691 millirem and estimated the activity of plutonium to be 1.76 nano-curies. Facility management placed the inspector on administrative duty to limit radiation exposure pending an investigation. (ORPS Report SR--WSRC-HPIH-1995-0001)

**KEYWORDS:** radiological contamination, uptake, bioassay, continuous air monitor

**FUNCTIONAL AREAS:** Industrial Safety, Materials Handling and Storage, Radiation Protection, Work Planning

## 3. ENERGIZED SOLENOID NOT LOCKED OUT

On March 24, 2000, at Savannah River, electrical and instrumentation mechanics discovered an energized 120-V solenoid valve that was being replaced. Their review of the lockout/tagout order revealed that this solenoid was energized from a power source not identified in the lockout. No personnel injury or damage to equipment resulted from this incident. Use of inadequate procedures or deviations from written procedures may result in adverse effects on performance, safety, or reliability. (ORPS Report SR--WSRC-LTA-2000-0008)

Investigators determined that a problem existed with red-line drawings. The solenoid valve appeared on circuit drawings but not on the single line drawing. Furthermore, drawings contained conflicting information within the

same drawing and from one drawing to another. Configuration management was not completed when field components were labeled and the old drawings were not updated properly. Investigators determined that there was inattention to detail during the preparation, review and walkdown of the lockout/tagout order. The review and walkdown of the lockout/tagout order occurred concurrently and identification of the exact component being locked out was not confirmed during the drawing review or walkdown. Facility personnel were not aware that there had been any changes to existing red-lined facility drawings. An electrical engineer did not review the lockout/tagout order. The electrical and instrumentation mechanics performing the replacement were confused by the multiple power sources and the fact that the solenoid valve was fed from a separate power source from the one locked out. The red-line drawings were not freely shared among all engineers involved in preparation, review, and walkdown of the lockout/tagout and the component replacement.

Facility management has proposed several corrective actions.

- Consider establishing a centralized location for red-line drawings;
- Communicate the expectation that a component being worked has its power source identified on drawings;
- Monitor group reviews and walkdowns;
- Include drawings at the component level with lockout/tagout packages;
- Solicit feedback from work groups regarding similar facility set-ups;
- Increase caution in cases with inadequate facility drawings;
- Evaluate training opportunities for lockout/tagout writers and reviewers;
- Review methods for changing labels in the field;
- Perform drawing reviews to ensure as-built conditions and all subsequent changes are reflected in red-line prints.

EH engineers have reported similar occurrences involving inadequate drawings and improper lockout/tagout.

- Operating Experience Summary 99-22 reported that on May 21, 1999, at Los Alamos National Laboratory, the facility manager designee for the Plutonium Processing and Handling Facility reported an electrical near miss associated with the replacement of a vacuum pump. Electricians had wired a new control panel for the replacement pump using an existing 480-V AC power source even though the control circuits were designed for 208-V AC. The design change package (DCP) for the work clearly said that no changes to the existing electrical power would be required, and no electrical drawings, which would have shown the 208-V AC requirement for the control circuits, were provided with the DCP. Electricians discovered the wiring problem before the control circuits were energized. The facility manager designee issued a formal stop-work order on the pump replacement activities. (ORPS Report ALO-LA-LANL-TA55-1999-0030)
- Operating Experience Summary 97-31 reported that on July 22, 1997, at the Savannah River Site, a subcontractor mechanic used a non-documented lockout/tagout (allowed only for isolation of a single energy source) to lockout a cabinet that had more than one electrical feed. The mechanic installed the lockout to de-energize a 480-V electrical source while troubleshooting and repairing a laboratory heating, ventilation, and air conditioning system. While the mechanic was working on the system, an auditor from Central Services Works Engineering discovered that the cabinet contained an energized 120-V electrical feed in addition to the 480-V source. The mechanic immediately stopped work, notified a custodian, removed his lock, and assisted in identifying the source of the 120-V feed. A documented lockout should have been used because multiple sources of electrical energy were inside the same cabinet, but work planners failed to identify the other source. (ORPS Report SR--WSRC-TNX-1997-0005)

The facility manager conducted a critique of the event on July 24, 1997. Critique members determined that the work planners did not review as-built electrical drawings that showed the presence of the 120-V electrical source and did not perform a walkdown of the cabinet to identify any additional hazards before turning the job over to the mechanic. Work planners prepared two separate work clearance permits, one to conduct troubleshooting and one for repair.

- Operating Experience Summary 97-04 reported that on January 11, 1997, at Hanford, an electrician received minor flash burns when he reconnected energized 480-V power leads to a motor control center main breaker. The electrician did not receive an electrical shock. The electrician and a coworker believed the circuit was de-energized based on their interpretation of electrical system drawings and an earlier zero energy verification. The electrician received only minor burns because he was wearing the required protective clothing. The shift manager stopped all work in the area and directed electricians to de-energize the electrical power. Emergency medical response team members transported the electrician to the hospital, where he was treated and released. Investigators determined there was an inconsistency between the electrical system configuration and the system drawings. (ORPS Report RL--PHMC-S&W-1997-0001)

**KEYWORDS:** Conflicting drawings, lockout/tagout, energized electrical component

**FUNCTIONAL AREAS:** Maintenance, Configuration Control, Electrical Engineering

#### 4. INSUFFICIENT SHIELDING AT TEST AREA NORTH HOT SHOP

On March 17, 2000, at Idaho, engineers verifying the safety features within the Hot Shop identified two straight through design penetrations that did not have sufficient shielding. The review was part of the process of upgrading the Test Area North (TAN) Hot Shop Special Equipment Service (SES) Room from a hazard category 3 to a hazard category 2 area. Additional precautions were taken to prevent an inadvertent criticality incident involving Three Mile Island (TMI-2) canisters stored in this room. There were no known work injuries or damage to equipment as a result of the discovery. (ORPS Report ID--BBWI-TAN-2000-0009)

Investigators found that the Hot Shop and SES room have been used for handling fissile material since the 1950's. These facilities house operations that involve the possibility for inadvertent criticality. Engineers performed safety feature verifications (radiation shielding) for the SES room prior to initiation of dewatering/drying operations with TMI-2 canisters and identified two straight through concrete penetrations. Several additional penetrations were identified in the TAN Hot Shop from a review of facility drawings. Investigators could not determine if the penetrations or spaces around the shield windows would provide adequate shielding from the postulated criticality accident scenarios in the TAN Safety Analysis Report (SAR).

Investigators learned that the two SES room straight-through penetrations were back-filled with steel wool. The approved method used during maintenance operations on the TAN Hot Shop penetrations or maintenance on the Hot Shop Windows is back-filling with either steel wool, steel shot or lead shot. Engineers assumed that the substantial shielding stated in the TAN Safety Analysis Report meant stepped concrete in windows and penetrations to prevent radiation streaming (neutron or gamma). All shield window installation ports are not stepped but are straight through square, rectangular, or trapezoid cutouts. Standard shield windows were placed into these cutouts and the remaining voids filled with either steel or lead shot. These designs are similar to the SES windows and penetrations.

The current safety analysis report implements the requirement for double contingency to prevent an inadvertent criticality, where a criticality is deemed credible. The derived technical safety requirements are appropriate, have been implemented to prevent a criticality, but are premised on the fact that the TAN Hot Shop has substantial shielding. The Idaho Operations Office has declared the existence of an unreviewed safety question based upon the assumption that the Hot Shop is not well-shielded.

EH engineers have reported similar occurrences involving inadequate shielding in the following Summaries:

- Operating Experience Summary 96-03 reported that on January 8, 1996, operators at a commercial nuclear plant discovered an unattended fuel assembly in the fuel handling bridge mast. The assembly was suspended over its spent fuel pool storage location with the lower end fitting nearly flush with the top of the storage position. This provided 10 feet of water above the top of the fuel assembly for radiation shielding. Operators lowered the assembly into its storage rack location. (NRC Event Number 29817)
- Operating Experience Summary 95-34 reported that on August 19, 1995, fuel handlers at the Idaho National Engineering Laboratory reported a potential unreviewed safety question raised by placement of an underwater fuel storage rack in a location where lateral radiation shielding was inadequate. When fuel handlers placed

nuclear fuel into the rack, it caused radiation levels in an accessible area of the fuel handling building to be higher than posted. Radiation technicians determined that no employees were in the accessible area at the time of the event. Fuel handling managers suspended work in the area until engineers completed a safety evaluation. (ORPS Report ID--LITC-FUELCSTR-1995-0010)

- Operating Experience Summary 93-43 reported that on October 19, 1993, workers at the Idaho National Engineering Laboratory waste processing tank farm found that the access way to a spare high-level radioactive waste tank was void of dirt shielding, contrary to Plant Safety Document requirements. The tank was last accessed in 1972 and personnel had prepared for the possibility that the dirt had been removed. According to the Plant Safety Document, the dirt shielding is required to protect personnel from direct radiation in the event the tank is filled with high-level radioactive solution. There were no contamination releases or personnel overexposures as a result of the incident. However, facility personnel reported that extremely high radiation fields could have resulted if the tank had been filled with high-level radioactive waste without the presence of the dirt shielding. (ORPS Report ID--WINC-WASTEMNGT-1993-0008)

**KEYWORDS:** Inadequate shielding, radiation shielding, criticality

**FUNCTIONAL AREAS:** Health Physics, Nuclear Engineering, Worker Safety

## 5. DAMAGED ELECTRICAL CONDUITS

On March 3, 2000, at Los Alamos National Laboratory, an electrician discovered that an electrical conduit and wiring were severed at the Pulsed High-Energy Radiographic Machine Emitting X-rays (PHERMEX). The 120-V energized circuit was cut prior to February 11, 2000, during a core-drilling operation to install a pipe for a fire protection system upgrade. The circuit breaker did not trip. There was no impact to the health or safety of personnel or the environment. Nevertheless, an undiscovered hot wire presented a potential ground fault condition and a shock hazard to workers. (ORPS Report ALO-LA-LANL-FIRNGHELAB-2000-0003)

A second event occurred on March 27, 2000, at the Pantex Plant, when a contractor employee was moving a conduit while cleaning a foundation trench. The conduit separated or broke at a tee conduit fitting, pinching or nicking the insulation. This caused a direct electrical contact with the side wall of the conduit and a resultant electrical arc. There were no injuries to personnel, or damage to equipment or facilities as a result of this incident. Improper handling of known energized 110-V wiring resulted in a near miss and potentially serious worker injury. (ORPS Report ALO-AO-MHC-PANTEX-2000-0028)

In the first event investigators determined that the conduit that controlled building exterior lighting was severed during the installation of an aqueous film forming foam (AFFF) system in Building 185. The installation required two pipes, one for water and the other for the AFFF concentrate. Investigators concluded that the conduit was cut while drilling a four-inch diameter hole through an existing concrete, rebar reinforced, 18-inch thick wall to accommodate one of the pipes. Contract employees used ground-penetrating radar from outside the wall to guide the drilling but mistook the one-inch conduit for a rebar. This wire was only noted but not shown on as-built drawings. Investigators learned that the workers coring through the wall were wearing insulated gloves and the coring machine was also insulated.

An operator at PHERMEX discovered the facility's exterior lights were not working on February 11, 2000. Electricians sent to repair the exterior lights a week later reported the cut electrical conduit and wiring to the operator and pulled a new wire. The environment, safety and health officer has ordered that a ground-penetrating radar scan be done of both sides of a suspect wall to confirm that no other conduit is damaged during future penetrations for piping or new installations of conduit. Project management will notify contractors and subcontractors that ground-penetrating radar has been conducted before penetration are made into walls, floors, and ceilings and also consider additional training for workers who perform ground-penetrating radar surveys.

In the second event investigators found that a contractor employee was cleaning a foundation trench in preparation for a concrete retaining wall at the junction of the dirt overburden and the ramp roof. An existing above ground 40 to 50 foot long energized electrical conduit containing 110-V wiring crossed the work area being cleaned. The conduit, removed from a demolished stairway and lowered to the dirt overburden, contained a 120-V receptacle intended for electrical service for power tools in lieu of a extension cord. A contractor employee moved the above grade conduit with a nonconducting wooden handle shovel to clean underneath the conduit. The conduit separated or broke at a tee conduit fitting behind an existing dehumidifier and air handling unit pinching or nicking the

insulation causing direct electrical contact with the side wall of the conduit and an electric arc. Investigators determined that construction workers and electricians and contractor management knew that the energized conduit should have been locked and tagged out. The contractor claimed that the conduit was to be installed on a newly constructed stairway although the differences in elevation precluded use of the same conduit. The claim was also made that the construction area was subjected to heavy foot traffic and this conduit would have taken more abuse than an extension cord in the same area. Investigators concluded that poor work practices exist that should be remedied.

EH Engineers have reported similar occurrences involving damaged conduit in the following Summaries:

- Operating Experience Summary 99-35 reported that on August 23, 1999, at the Pantex Plant, a construction manager learned that a contractor had cut into a conduit containing a 480-V electrical cable with a band saw. The contractor was supposed to remove a conduit for a public address system that contained low-voltage wiring but accidentally started to cut into the wrong conduit. A supervisor saw the contractor cutting the conduit, realized the mistake, and stopped him before the saw contacted the energized cable. The 480-V cable provides power to an air handling unit in a building bay. The air handling unit was not operating at the time of the incident. The contractor was fortunate that he was stopped in time to prevent an electrical shock or injury. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0060)
- Operating Experience Summary 98-43 reported that on October 19, 1998, at the Idaho National Engineering Environmental Laboratory Test Reactor Area, a construction subcontractor severed an energized 220-V, 20-amp evacuation siren electrical circuit while drilling through a composite steel/masonry block wall. Facility personnel tagged the siren out of service. Investigators determined that the conduit was concealed between the exterior steel siding and the building masonry block. The facility manager directed construction personnel to stop all project construction work until further investigation and corrective actions are completed. (ORPS Report ID--LITC-TRA-1998-0019)
- Operating Experience Summary 95-02 reported that on January 3, 1995, personnel at Idaho National Engineering Laboratory New Waste Calcining Facility (NWCF) reported that on December 31, 1994, construction subcontract personnel were core drilling a four-inch hole through a cell wall when they penetrated two conduits. Projects personnel immediately stopped further core drilling operations. One conduit contained a cable with 120 V and 480-V AC conductors. The power had been isolated from these conductors because of an outage on a crane. The other conduit contained instrumentation cable that was not in use. Neither of the cables were damaged by the core drill. The NWCF converts liquid acidic radioactive waste into a stable, more easily stored solid. (ORPS Report ID--LITC-WASTEMNGT-1995-0001)

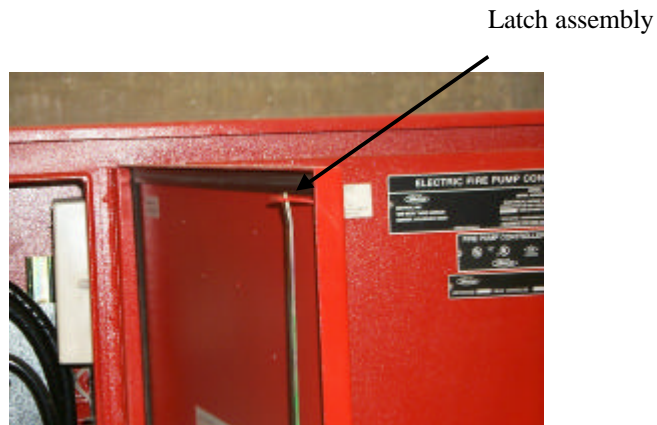
**KEYWORDS:** Damaged conduit, construction safety, electrical safety, work control

**FUNCTIONAL AREAS:** Construction Safety, Worker Safety, Electrical Engineering

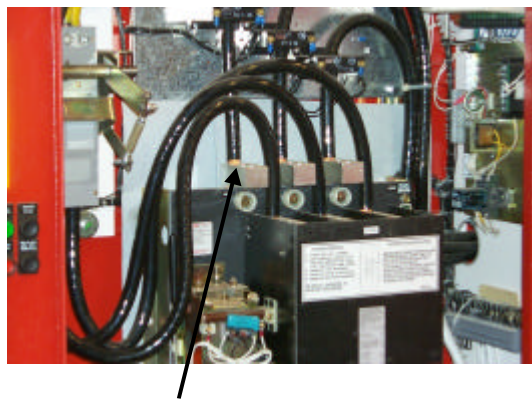
## 6. 480-V AC ELECTRICAL NEAR MISS

On March 15, 2000, at the Hanford Site, an electrician attempted to close a 480-V AC cabinet after taking voltage readings for a flow test on a fire pump, when the bottom bar of the slide mechanism fell to the floor and the upper bar fell into the electrical cabinet. Though no personnel injuries or electrical problems occurred, there was a potential that the upper bar could have come in contact with live 480-V electrical lugs and could have caused arcing in the cabinet, endangering workers' safety. (ORPS Report RL--PHMC-S&W-2000-0004)

Investigators discovered that the crew was wearing only regular personal protection equipment, as it was not considered an electrical (hot) work assignment. The electrician retrieved the bottom slide and upper bar (Figure 6-1). The crew reassembled the lower and upper guide mechanisms of the cabinet door and restored the latching system to working condition. The electrician then checked the door mechanism of the adjacent cabinet and found that the lower slide bar was bent and had slipped out of its guide. The crew straightened the bent slide, put it back in its original position and shut the door. The team's craft supervisor notified the line management about the corrective actions taken. Investigators from Operations and Maintenance inspected the repaired latch assembly and determined that there was no potential for the upper bar to contact the energized sources (Figure 6-2). The operations Management checked similar latch mechanisms of the doors of 12 other electrical cabinets in the area as a precaution and found all in sound working condition.



**Figure 6-1. Door Latch Assembly**



**Figure 6-2. Exposed Energized Contacts**

EH engineers identified the following similar events in the ORPS database.

- On April 16, 1998, at Lawrence Livermore National Laboratory, two outer emergency exit doors failed to pass requirements during the annual surveillance. The doors did not close and latch completely within one minute after being opened 90 degrees. These doors are a safety class system. A visual inspection showed no apparent wear or blockage. The Facility was in Maintenance Mode for this and other routine surveillance requirements. The maintenance personnel adjusted door mechanisms and the doors passed the surveillance test. Preventive maintenance and regular surveillance of safety related devices provide a sound safety net to operating personnel at DOE facilities. (ORPS Report OAK--LLNL-LLNL-1998-0021)
- On June 15, 1998 at Savannah River Site, an SMI-51 Final Acceptance Inspection was being conducted at the F-Area Ground water Waste Treatment Unit (F GW WTU). A Project Engineer and a Construction STR were inspecting the interior of the Control Panel for the new Filter Press when the Safety Engineer asked if the control panel was de-energized and locked out. The panel was inspected and found to be de-energized but not locked out and the job was stopped. A non-documented lock out was then placed on the control panel and the inspection resumed. The F&H Groundwater Facility Manager reported this occurrence to ERD Safety & Health SIRIM two hours later to determine if it was reportable. It was determined as being reportable and the event was classified, notifications were made, and later a critique was held. The inspection personnel stopped work when the panel was discovered to be not locked out. The operations management placed a non-

documented lock out on the feed to the control panel for completion of inspection. The root cause identified was personnel error and contributing cause was training deficiency. (ORPS Report SR--WSRC-ERF-1998-0006)

The voltage range on this panel is 24VAC to 460VAC and it is designed not to open without placing a disconnect switch in the "off" position. This switch was off, but was not locked out before the start of the inspection and exposed personnel to hazardous energy.

These events underscore the importance of regular preventive maintenance of safety related systems, periodic surveillance and questioning attitude of operations and inspection personnel in enhancing safety at DOE sites. Proper vigilant conduct in performing various tasks and evolutions have added value in considerably reducing personnel injuries.

The following DOE standards regarding guidance on preventive maintenance and surveillance and qualification and training of maintenance personnel can be found by accessing the following websites.

- DOE Order 4330.4B, Maintenance Management Program requires periodic maintenance of the Department's facilities for safe operations, at <http://www.explorer.doe.gov:1776/htmls/directives.html>.
- DOE-HDBK-1003-96, Guide to Good Practices for Training and Qualification of Maintenance Personnel, at <http://tis.eh.doe.gov/techstds/standard/hdbk1003/hdbk1003.pdf>

**KEYWORDS:** maintenance, training deficiency, surveillance

**FUNCTIONAL AREAS:** Preventive Maintenance, Training

## 7. AS-BUILT DRAWING DISCREPANCY LEADS TO HIGH VOLTAGE ELECTRIC SHOCK

On March 28, 2000, at Hanford, an electrical worker received a 277-V electric shock while he repaired a lighting circuit. The worker performed a zero energy check under an authorized worker lock when the incident occurred. Facility management transported the worker to the medical aid station for a precautionary evaluation, held a critique meeting to identify the cause of the event, and performed a walkdown to verify the accuracy of electrical drawings. The worker returned to work with no restrictions following his medical evaluation. There were no injuries associated with this event. Incorrect or otherwise inaccurate drawings can fail to indicate actual facility conditions and lead to serious injury. (ORPS Report RL--PHMC-TPLANT-2000-0002).

Investigators determined that the electrical worker discussed the need for an authorized worker lock with the lock and tag coordinator and they concluded that the correct light fixture circuit breaker was one of the two possible breakers indicated on the electrical drawing. Investigators determined that the electrical worker applied the authorized worker lock, climbed a ladder and began to disassemble the light fixture to access the fixture's wiring to perform a safe condition check. They determined that as the electrical worker removed a wire nut to expose fixture wiring, a wire came loose and brushed his index finger giving him a shock. Investigators determined that after the electrical worker climbed down the ladder he surmised that the other identified breaker was the correct one and he reapplied the authorized worker lock to that breaker to complete the repair work.

During the critique meeting, investigators determined that the electrical drawing used for the task was not the latest revision and that no version of the drawing indicated that two power sources fed the light fixture. Investigators also determined that the drawing referenced by the drawing used to perform the lockout, did indicate two separate power sources feeding the light fixture. They determined that the reference drawing did not clearly show that two sources were present.

EH engineers identified the following events involving unforeseen electrical hazards or less than accurate drawings or procedures.

- Operating Experience Summary 98-50 reported that on December 4, 1998, at the Rocky Flats Environmental Technology Site, a construction electrician attaching a light fixture to a wall received an electrical shock when conduit from the light fixture contacted a junction box. Workers in the area stopped work and the electrician was sent to the medical department for an evaluation. Medical personnel determined that the electrician did

not experience any harmful effects. Investigators determined that the junction box was powered from another junction box embedded inside the wall and that because of a defect in the facility electrical distribution system there was no ground path between the junction boxes. In addition, an emergency light attached to the outside of the junction box failed. Together, the defect and the failure caused the junction box to be energized to 218.9 V. (ORPS Report RFO--KHLL-371OPS-1998-0084)

- Operating Experience Summary 97-45 reported that on October 30, 1997, at Sandia National Laboratory, a technician received a shock from a partially charged capacitor when he removed a cable from a fixture in a fluorinert-filled test tank. The technician inadvertently touched the coax connector shell at one end of the cable to a resistor in the circuitry while his hand was on the tank. This completed the circuit to ground and allowed the capacitor to discharge. The technician was not injured, and there was no equipment damage. Investigators later determined that someone added the capacitor to upgrade the system 3 months earlier and did not revise procedures to reflect the upgrade. (ORPS Report ALO-KO-SNL-1000-1997-0008)

**KEYWORDS:** electric shock, as-built drawing

**FUNCTIONAL AREAS:** Industrial Safety, Configuration Control, Hazards and Barrier Analysis

## 8. INSULATING FOAM INCREASES FACILITY COMBUSTIBLE LOADING

On March 23, 2000, at Oak Ridge National Laboratory, fire protection engineers conducted a fire hazards analysis as part of a safety analysis report upgrade and discovered a highly combustible polyurethane insulating foam used on various surfaces in the facility. Facility management hired an independent research organization as part of the fire hazards analysis to perform a detailed evaluation of the insulating foam and the fire protection system. There were no injuries associated with this event. Facilities can contain combustible or flammable materials that introduce unrecognized increases in fire loading. (ORPS Report ORO--ORNL-X10CHEMTEC-2000-0006).

Investigators learned that in 1973, an Atomic Energy Commission-sponsored review identified concerns that the ceiling level automatic fire protection sprinklers were not adequate to extinguish an insulating foam fire. They learned that the review team recommended that facility management install multilevel sprinklers along the foam-covered walls as an acceptable alternative to removing the foam insulation. Investigators determined that facility management implemented this corrective action and that a follow-up review in 1985 resulted in no findings or additional corrective actions. In recent tests investigators determined that the foam is easily ignitable and exhibits the ability to sustain a self-propagating fire. Investigators also determined that once ignition takes place, the fire has the potential to travel more quickly than the response time index for the existing standard sprinklers and that most if not all sprinklers would be triggered resulting in reduced individual sprinkler operating pressures.

The Department of Energy stated that facility operations can continue provided that the following corrective actions are implemented.

- Oak Ridge Fire Department personnel conduct routine fire safety inspections to confirm the effectiveness of the efforts to limit the presence of combustible materials;
- Facility personnel conduct weekly combustible loading checks as part of their rounds;
- Facility management adequately communicate the significance of this issue to facility personnel, and;
- Facility management posts a durable sign at the area entrance prohibiting welding, burning, and storing flammable and combustible materials.

EH engineers identified the following event involving unexpected increases in combustible loading.

- Operating Experience Summary 99-46 reported that on November 1, 1999, at the Pantex Plant, fire protection engineers identified safety concerns while testing rubber floor mats for ignition and combustibility. Pantex Weapons Program procedures require the combustible loading to be minimized, justified, and approved by fire protection engineers. Honeycomb rubber floor mats are used at the facility to reduce the risk of a high explosive drop in areas where high explosives safety is a factor. Various ignition tests demonstrated that the

rubber mats ignited during credible fires making them a significant source of fuel. Fire protection engineers recommended removing the mats and replacing them with a noncombustible material or covering them with a noncombustible material. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0074)

**KEYWORDS:** fire, combustible, ignition, combustible loading

**FUNCTIONAL AREAS:** fire protection